

A CLOSER LOOK



...at
Estuary Research



A great blue heron (left) and an osprey take a break from hunting for fish on the Caloosahatchee Estuary. Man and bird often fish for the same species.

An Estuary is a waterway that contains a mixture of fresh and salt water

Estuaries are the transition zone between rivers and the sea and provide habitat for a unique collection of plants and animals, which have both aesthetic and commercial value. It is here that freshwater, draining from the land, mixes with salt water from the ocean. This combination of sea water diluted with nutrient-laden freshwater from the land allows estuaries to support the vast seagrass meadows, mangrove fringes and many kinds of fish and shellfish that live in these systems.

Estuaries are valuable to society for many reasons. Because they provide a sheltered access to the open

sea, many cities are located on estuaries to take advantage of commercial shipping and recreational boating opportunities. Estuaries not only support local fish and shellfish populations that are harvested commercially and recreationally, but these waters also serve as spawning and nursery grounds for populations that are harvested offshore. Also, because of their proximity to the ocean, estuaries have been traditionally used as convenient disposal sites for urban stormwater runoff and sewage. Because the rivers that feed them are often used for this same purpose, estuaries can become severely impacted by municipal and industrial waste.

Estuaries require freshwater to exist, and canals maintained by the

In review...

- During the rainy and dry seasons, estuaries receive either too much freshwater or too little.
- Seagrass, oysters, scallops and fish that live in estuaries depend on a mixture of fresh and salt water for survival.
- Determining the best mix of fresh and salt water and lowering the amount of pollutants entering the estuaries will help protect and restore vast communities of sea life.

South Florida Water Management District supply much of the water to south

too much freshwater. This occurs for several reasons. For some, like the St. Lucie Estuary, the

may become starved for freshwater. Withdrawal of water from the canals for irrigation, drinking, and other uses means that water, which would normally reach the estuary, does not get there. This unnatural delivery of runoff causes extreme variation in the proportions of fresh and salt water in the estuary. During the wet season, there may be too much freshwater, while during the dry season there may be too much salt water. In either case, estuarine plants and animals suffer.

Estuaries in south Florida are changing. They have been dredged. Causeways and bridges have been built. Cities with sewage treatment plants and storm drains have sprung up on their shores. The canal system has changed the way freshwater is delivered to estuaries. Coincident with these changes are documented losses of vital



This intertidal mangrove forest is one reason estuaries are so productive. Mangroves convert nutrients, carried by freshwater runoff, into food and shelter for many important fish and shellfish.

Florida's estuarine ecosystems. Unfortunately, the canal system that protects this area from flooding and supplies water for agriculture, industry and municipal purposes, delivers water to estuaries in an unnatural way. While freshwater is good for estuaries, too much or too little can be bad.

During the rainy season, estuaries in south Florida tend to get

construction of Florida's canal system has increased the area of land that feeds water into the estuary. Also, the runoff generated by a typical Florida thunderstorm is not slowed down by meandering streams or held back by marsh land. Rather, it reaches the estuary faster, in a large pulse.

In addition, the Caloosahatchee Estuary on the west coast and the St. Lucie on the east coast have been artificially connected to Lake Okeechobee for water supply and flood control. When water levels in the lake get too high, water is released to these estuaries through a series of gates and canals. During the dry season, estuaries

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Because estuaries provide sheltered harbors, they are prime sites for urban and suburban development. The degraded water quality and habitat loss that accompanies such development can disrupt commercial and recreational fisheries.

seagrass beds and oyster bars as well as degraded water quality and fish kills. Scallop beds, which used to support commercial fisheries, have vanished. The District's goal is to manage freshwater discharge to south Florida's estuaries in a way that preserves, protects and where possible, restores essential estuarine resources.



District scientists perform controlled experiments in a laboratory to help determine how much freshwater estuaries need. This researcher is determining the quantity of plant material produced at different salinities.

Estuary research is determining how much freshwater is needed and when

The District estuarine research program has two primary goals. The first is to determine not only how much freshwater seagrass meadows, oyster bars and other estuarine resources

ent scientific techniques to make these determinations -- field surveys, field and laboratory experiments, water quality modeling and long-term monitoring. These techniques are employed in a complimentary way to provide the high-quality information required by

environmental managers. The process is illustrated below.



The quality of water is important to the plants and animals that live in an estuary. District researchers conduct field surveys to determine how water quality changes according to freshwater discharge.

need, but also, when they need it. The second is to understand each estuary well enough to predict the consequences of changes in water management. District staff uses several differ-

clams, early life stages of fish and seagrasses are taken on a regular schedule throughout the year. These data allow District scientists to correlate changes in water quality and populations of

plants and animals with changes in freshwater discharge. So far, the District has conducted surveys of the Loxahatchee, Caloosahatchee, and St. Lucie estuaries.

Experiments: The observational data collected on surveys is also used to generate hypotheses that can be tested experimentally. Sometimes, experiments are conducted in the field and sometimes in the laboratory. For example, District scientists have been testing the hypothesis that salinity (how salty the water is) controls the distribution of seagrasses in the Caloosahatchee Estuary. In the field, researchers have transplanted various types of seagrass, both upstream in the estuary where the water is fresher, and downstream where the water is saltier, to monitor the growth and survival of the plants.

Because other environmental factors besides salinity may change along the upstream-downstream gradient, highly controlled experiments are also conducted in a laboratory. Here, plants



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are grown at different salinities, and other environmental factors such as temperature and light are held as constant as possible. Only salinity is allowed to vary, and any visible effects on growth or survival are caused by differences in salinity. If results of field experiments are simi-

Some estuaries in south Florida have been so altered that a return to their original state is unlikely.

lar to the results of laboratory experiments, then researchers can conclude that salinity exerts a major control on the distribution of seagrass in the Caloosahatchee Estuary.

Water Quality Modeling: The District is in the process of formulat-



An estuarine researcher inspects dead catfish from the Caloosahatchee. Poor water quality can degrade estuarine resources and may even cause significant mortality. District scientists are setting pollution load reduction goals to ensure good estuarine water quality for a growing population.

ing mathematical models of the Caloosahatchee and the St. Lucie estuaries. These models will enable scientists to predict the distribution of salinity and other water quality parameters as a function of freshwater discharge from canals and other sources. In combination with experimental data, these models can be used to identify the range of freshwater

discharges that promote a healthy estuary. The models can also be used to predict the consequences of both short-term discharge events such as a release of water from Lake Okeechobee and long-term changes in water management.

Monitoring: Implementing a management strategy is pointless without some way of evaluating success or failure. Long-term monitoring programs provide the information necessary to make such judgments. Researchers are testing sampling tools and methods that will provide high-quality information in a cost-effective manner. For example, staff has tested and is implementing the use of a hydroacoustic system to monitor annual changes of seagrass in the Caloosahatchee Estuary. This system replaces more labor intensive, manual techniques.

Some estuaries in south Florida have been so altered that a return to their original state is unlikely. For example, the dredging of the St. Lucie Inlet allowed ocean water to intrude directly upstream, turning the St. Lucie into an estuary. It is unlikely that such man-made inlets will be closed. Nevertheless, the health of south Florida's estuaries can

be maintained and restored. Once researchers determine the amounts and frequencies of freshwater delivery, research will focus on setting pollutant-reduction goals for nutrients and other materials of concern. This will ensure that estuarine resources receive not only the right amount of water at the right time, but also clean water of good quality.

What's ahead...

- Identify environmental conditions that favor the growth of viable seagrass habitat in estuaries within the District's oversight.
- Quantify nutrient input and cycling.
- Develop water quality models.
- Determine minimum and maximum freshwater input levels.
- Establish loading range for nutrients and other materials of concern.
- Apply innovative technologies to long-term monitoring.



For more information on Estuarine Research, please contact the SFWMD at (561) 686-8800.

For news on other SFWMD research projects, please see the following *Closer Look* publications:

- AN OVERVIEW OF CURRENT SFWMD RESEARCH
- EVERGLADES RESEARCH
- KISSIMMEE RIVER RESEARCH
- LAKE OKEECHOBEE RESEARCH
- SOUTHERN EVERGLADES AND FLORIDA BAY RESEARCH
- STORMWATER TREATMENT AND SUPPLEMENTAL TECHNOLOGY RESEARCH

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Field Surveys: The intent of field surveys is to characterize an estuary under a variety of different conditions and establish long-term trends. Samples for water quality, benthic invertebrates such as

clams, early life stages of fish and seagrasses are taken on a regular schedule throughout the year. These data allow District scientists to correlate changes in water quality and populations of



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